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Arjasa Village farmer assistance in cassava peel and Trichoderma fungus processing as organic fertilizer

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ABSTRACT

Tumbang Nusa Village, located in Central Kalimantan, has natural resources in the form of purun plants, which can be utilized as raw materials for environmentally friendly products, one of which is purun straw. However, the traditional drying process produces inconsistent product quality and low productivity. This community service program aims to empower the Nusa Sehati Joint Business Group (KUB) by introducing appropriate technology as a purun straw dryer. The program consists of several stages, including problem identification, community service preparation, socialization, demonstration, and evaluation of the purun straw dryer's usage. The activity resulted in a significant increase in both production efficiency and product quality. The drying time, which initially took 3-4 days, was reduced to just 40 minutes, and the quality of the purun straws became more consistent, with each straw losing 22 percent of its mass during drying. Evaluation results from pre-test and post-test assessments revealed a significant increase in participants' understanding. Before the training, 80 percent of participants were aware of this technology, but only 53 percent had used it. After the training, 93 percent of participants stated that the technology was effective, and 100 percent reported improvements in the quality of purun straws. These results demonstrate the program's success in enhancing knowledge and productivity.

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1. INTRODUCTION

Arjasa Village, located in the Arjasa District of Jember Regency, East Java, faces a series of challenges related to agriculture, particularly in meeting the fertilizer needs of local farmers. With a total rice field area of 278.06 hectares, the farmers, including those in the Sumber Tani Farmers Group, cultivate crops like tobacco and corn. However, they face significant issues, such as limited access to chemical fertilizers, especially subsidized urea, which is essential for plant growth. Around 80 percent of Indonesian farmers rely on chemical fertilizers, which play a critical role in improving crop productivity (Yusmayani, 2019).

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In addition to fertilizer challenges, Arjasa Village also faces a serious waste management problem. Cassava peel, a byproduct of cassava processing, is abundant in the village. In 2021, cassava production in the village reached 1,238.40 tons annually, producing significant amounts of waste from the 12 local UMKM (small businesses) that process cassava into products like chips and *tapai*. These businesses generate between 12.5 and 15 kg of cassava peel per week, which typically accumulates as waste, contributing to environmental pollution when discarded improperly.

To address these issues, organic fertilizers can be a sustainable alternative. Organic fertilizers, derived from natural materials such as animal manure, plants, and agricultural by-products, improve soil fertility and contain high mineral content (Putra & Ratnawati, 2019). One promising solution is the use of cassava peel as raw material for organic fertilizer production. Cassava peel contains nutrients essential for plant growth, including protein, fiber, pectin, fats, and calcium. For example, 100 grams of cassava peel contain 8.11 grams of protein, 15.20 grams of fiber, and 0.63 grams of calcium. When degraded by microorganisms, the protein breaks down into ammonia, which can enhance soil quality but may produce an unpleasant odor (Sulistyowati et al., 2022).

To further enhance the fertilizer's nutrient content, Trichoderma fungi can be added. Trichoderma produces antibiotics and enzymes that protect plants from diseases and aid in breaking down the cell walls of pathogens (Rosiman et al., 2020). Furthermore, Trichoderma can improve nitrogen content, which is vital for promoting plant growth, especially for vegetative growth such as leaves, roots, and stems. This nitrogen boost can also make the plant leaves appear greener, signaling improved plant health and growth (Nuraeni et al., 2019). Thus, turning cassava peel waste into organic fertilizer with the help of microorganisms and additives like Trichoderma is a promising and sustainable solution to address both the fertilizer shortage and environmental issues in Arjasa Village. The creation of organic fertilizer by the farmers' group requires proper planning to ensure that the results meet expectations. One way to achieve this is through community service programs, such as PROMAHADESA (Program Mahasiswa Berdesa), a program where a group of students plays a role in identifying and planning alternative solutions to problems by applying their academic knowledge.

The purpose of this community service program is to assist the Sumber Tani Farmers Group in Arjasa Village with the issue of organic fertilizer availability by utilizing cassava peel waste and combining it with Trichoderma fungi to enhance the quality of the fertilizer. The program aims to provide both understanding and practical skills in fertilizer production so that, in the future, the farmers will be able to independently produce their own fertilizer using the materials and procedures they have learned during the training. By implementing this program, the farmers will gain the knowledge and tools necessary to address the shortage of organic fertilizer in a sustainable and efficient manner, improving both their agricultural practices and environmental impact.

2. METHODS

Implementation Timeline

The Student Village Program (Promahadesa) activity was carried out in Arjasa Village, Arjasa District, Jember Regency. This activity was carried out from April to September 2024 with several stages, namely fertilizer production trials, socialization and training, fertilizer testing, and application to plants.

Activity Plan

The activity plan for the Village Student Program (Promahadesa) is to empower Arjasa Village through the utilization of cassava skin combined with Trichoderma fungi as organic fertilizer.

Table 1. Community service meeting schedule

1st Meeting	
Activities	- Introduction to the program - Introduction of the implementing team - Introduction of the product that will be made during the program implementation
Objectives	- Providing an overview of the objectives and benefits of the community service program that will be implemented - Introducing the group that will implement the program - Introducing the product that will be made, namely savaderma fertilizer
2nd Meeting	
Activities	- Trial of fertilizer making and fertilizer fermentation - Trial of Trichoderma fungi cultivation
Objectives	- Determining the best formulation, method of fertilizer making - Determining the best method of fertilizer fermentation to accelerate the process of organic material decomposition - Determining the best formulation and method of Trichoderma fungi propagation
3rd Meeting	
Activities	- Trial of mixing fertilizer and Trichoderma fungi culture and fermentation stage 2
Objectives	- Determining the best method of mixing fertilizer and Trichoderma fungi culture - Determining the best method of fermentation of fertilizer stage 2 after the process of mixing fertilizer with Trichoderma fungi
4th Meeting	
Activities	- Focus Group Discussion - Socialization of fertilizer making (best formulation and method) - Socialization of fungi propagation (best formulation and method)
Objectives	- Building mutual understanding between the promahadesa group and the farmer group Sumber Tani. Ensuring that farmers understand in depth the formulation of materials and each step in the fertilizer making process. - Ensuring that farmers understand in depth the formulation of materials and each step in the Trichoderma fungi propagation process.
5th Meeting	
Activities	Application of fertilizer to tobacco plants
Objectives	Knowing the effectiveness of fertilizer after being applied to tobacco plants
6th Meeting	
Activities	- Socialization of application results on tobacco plants - Socialization of the final product of savaderma fertilizer
Objectives	- Explaining the results obtained from the use of fertilizer on tobacco plants. - Comparing the results of using savaderma fertilizer with commonly used fertilization methods. - Increasing awareness of farmer groups or communities about the existence and benefits of savaderma fertilizer.

Equipments and Materials

The equipment used in the process of making fertilizer with a combination of Trichoderma fungi is a plastic gallon, napkin, stove, steamer, staples, plastic, digital scales, plastic tarpaulin, basin and pestle. While the materials used are cassava skin, Trichoderma fungi, corn rice, EM4, brown sugar, coconut water, sawdust and water.

Activity Method

Fertilizer making

Drying and smoothing cassava skin

The cassava skin is dried in the sun until dry, then the dried cassava skin is ground by pounding it until smooth, to make it easier in the next stage or mixing process.

Formulation measurement

Measurement of the formulation of the materials used needs to be considered from the amount of materials used. This aims to find the best formulation that is effective and efficient both in terms of benefits to plants and its impact on the soil.

Mixing ingredients

Mixing of materials is done when all materials are ready, mixing of materials is divided into three stages, namely in making fertilizer, fungi propagation, and mixing of all materials. Making fertilizer starts from mixing all materials from cassava skin that has been mashed, sawdust, young coconut water, brown sugar, and EM4 mixed in one gallon. Furthermore, in the fungi propagation stage, Trichoderma fungi propagation is carried out using corn rice. The last stage, namely the final mixing, includes mixing the results of fertilizer fermentation with Trichoderma fungis.

Fertilizer fermentation

Fertilizer fermentation is carried out for 7 days with a closed state by a napkin. After fermentation for 7 days, Trichoderma fungis and coconut water are added and then fermented again for 7 days.

Propagation of Trichoderma fungi

Corn-rice steaming

Fungi propagation is done by soaking corn rice overnight, then after soaking it is drained and put into 1 Kg plastic (weighing 200 g). Next, the corn rice is steamed for approximately 10 to 15 minutes until the texture is similar to tempeh (sticky to each other).

Increase in the number of fungi

The addition of Trichoderma fungi is done after the steaming process of corn rice, by inserting Trichoderma fungi into a plastic bag containing steamed corn rice that has been left to cool. After being inserted, stir or mix the corn rice and Trichoderma fungi until evenly distributed.

Fungi growing

The growth of Trichoderma fungi is done by placing the media that has been mixed with Trichoderma fungis in a damp place and away from sunlight and then leaving it for 7 days for the fungis to grow.

Socialization and training, fertilizer testing, and application to plants

Socialization and training were conducted to farmer groups on how to make and the results of fertilizer products involving detailed explanations of the fertilizer making process, from the selection of raw materials to the final stage of production. Farmers were also given insight into the right way to apply

fertilizer to plants, so that the results are optimal and environmentally friendly. In addition, this activity includes testing fertilizers in the laboratory to ensure the quality and effectiveness of the fertilizer. The final activity was the application of fertilizers to plants in farmers' fields to determine the impact of fertilizer administration on plants.

3. RESULTS AND DISCUSSION

Results

Savaderma is an innovative organic fertilizer made from cassava peel waste and enriched with Trichoderma fungi, designed to support sustainable agriculture. This fertilizer has the characteristics of a slightly sour aroma, a shape resembling soil, and a blackish brown color, Savaderma is easy to apply and mix with soil. There are several advantages of this fertilizer which include increasing soil structure and fertility, protecting plants from dangerous pathogens because there is the addition of Trichoderma fungi.

Figure 1. Savaderma fertilizer products

The Savaderma fertilizer product focuses on utilizing cassava peel waste as a substitute for urea fertilizer, along with the use of Trichoderma fungi, which is effective in suppressing pathogens and enhancing soil fertility (Tehuayo, 2023). During the socialization event, we conducted demonstrations or hands-on practices in fertilizer production. The fertilizer-making process involves fermentation for about two weeks. After the initial fermentation, coconut water and brown sugar solution are added to enrich the nutrients and support the growth of microorganisms (Derianto et al., 2021). Following this, Trichoderma fungi, which have already grown, are incorporated into the mixture, followed by an additional week of fermentation. The appearance of white mycelium on the surface indicates that the fertilizer is ready for use, signaling that the fungi are actively developing and seeking nutrients due to the ideal environmental conditions (Novianti, 2018).

The product development activities not only provide education to the community regarding the production of eco-friendly organic fertilizers but also hold significant potential to support the sustainability of the local agricultural sector. By reducing dependence on expensive chemical fertilizers that degrade the soil, this organic fertilizer presents a superior solution, offering both economic and ecological benefits for the Sumber Tani Farmers Group.

Implementation Stages

Presentation

The presentation was conducted as a way to deliver the theory behind utilizing cassava peel waste combined with Trichoderma fungi. The purpose of this material presentation was to provide

understanding to the Sumber Tani Farmers Group and the surrounding community on how to produce the fertilizer product. The material was presented through a discussion format by the Promahadesa group, followed by a Q&A session and practical fertilizer production by the Sumber Tani Farmers Group. The goal is for the farmers and the local community to be able to further develop this product and apply it as a substitute for urea fertilizer on their crops.

Explanation of stages

The explanation of the stages in making fertilizer from cassava peel waste was presented in the form of a final product—fertilizer that can replace urea. This was socialized to the Sumber Tani Farmers Group. The delivery of the material was done in accordance with the steps involved in making organic fertilizer, which had already been implemented. The stages were explained in detail, and then a hands-on fertilizer-making practice was conducted directly with the farmers of Arjasa Village. At the end, a final socialization was held regarding the benefits of using this fertilizer and the differences in its application compared to the usual fertilization practices followed by the Sumber Tani Farmers Group.

Activity materials

The partnership material with the Sumber Tani Farmers Group in this community service activity aims to develop innovations in organic fertilizer products derived from cassava skin waste and Trichoderma fungi, namely Savaderma fertilizer. This activity is driven by the potential that has not been optimally explored from the utilization of waste around for sustainable agriculture. By utilizing previous research that has been tested to obtain the best formulation in making savaderma fertilizer, this mentoring activity provides a comprehensive solution, starting from the production of savaderma fertilizer to its application to plants. In addition, the use of Savaderma organic fertilizer is expected to increase the sustainability of production and sustainable agriculture.

Table 2. Evaluation of activities

Program	Utilization of cassava skin with a combination of Trichoderma fungi as organic fertilizer
Program results	Fertilizer product "Savaderma"
Success indicators	- Understanding of Sumber Tani Farmers Group in utilizing cassava skin and Trichoderma mushrooms as organic fertilizer - Understanding of Sumber Tani Farmers Group in the formulation, method and fermentation of the best fertilizer production - Understanding of Sumber Tani Farmers Group in the formulation and method of mushroom propagation - Awareness of Sumber Tani Farmers Group about the benefits of applying Savaderma fertilizer compared to applying chemical fertilizers

The success indicators of this program include the farmers' understanding of the best formulation and methods for producing fertilizer as well as how to propagate Trichoderma fungi. Through the training or socialization previously conducted, the Sumber Tani Farmers Group was able to learn the formulation and methods for making fertilizer, as well as understand efficient fermentation techniques, allowing them to independently produce Savaderma. Additionally, increasing the farmers' awareness of the benefits of using organic fertilizers compared to chemical fertilizers is crucial, both economically and for environmental sustainability. The training and socialization provided helped raise awareness among

the Sumber Tani Farmers Group, enabling them to understand the advantages of Savaderma fertilizer. This understanding will motivate them to adopt sustainable agricultural practices more effectively.

Discussion

The Ministry of Trade Regulation No. 15/MDAG/PER/4/2013 categorizes subsidized fertilizers as goods whose procurement, distribution, and use are monitored by the government. However, according to research by Kautsar et al. (2020), while subsidized fertilizers are intended to support farmers, there is an ongoing issue of scarcity that has yet to be resolved. This scarcity is also felt by the Sumber Tani Farmers Group, who face difficulties in acquiring subsidized chemical fertilizers due to limited availability and high prices. To reduce dependence on subsidized chemical fertilizers, this farmers group is empowered through an innovation that uses cassava peel waste combined with Trichoderma fungi to create organic fertilizer.

Empowerment and mentoring activities have been conducted by other researchers, such as Abidin & Rohman (2020), who focused on empowering farmers through the production of organic fertilizers made from household waste, demonstrating strategies for processing domestic waste into alternative fertilizers. The methods used included socialization, training in fertilizer production, and continuous mentoring, involving local communities in the production process. Meanwhile, research by Suanda et al. (2021) in Dusun Kembang Sari, Desa Tukadaya, Kecamatan Melaya, Jembrana, Bali emphasized empowering farmers through training on plant-based pesticides and organic fertilizers, using an environmentally friendly agricultural technology transfer approach. These two studies share similarities in their focus on empowering farmers and developing organic fertilizers but differ in their sources of raw materials and locations.

Compared to the activities conducted by previous researchers, the mentoring activity in Arjasa Village shows significant innovation by utilizing cassava peel waste combined with Trichoderma fungi as the main components of organic fertilizer. The processing methods used are more advanced, incorporating microbiological techniques through Trichoderma fungi to optimize the quality and effectiveness of the fertilizer in a sustainable manner. The research stages are enriched by the direct application of the fertilizer to the farmers' crops, allowing for comprehensive monitoring of the differences in plant performance empirically. This holistic approach not only transforms agricultural waste into valuable resources but also provides concrete evidence of the potential of organic fertilizers in improving plant productivity and health.

Figure 2. Socialization of organic fertilizer production
Figure 3. Application of organic fertilizer to tobacco plants

The results from this empowerment include solid organic fertilizer (POP) with 36.70 percent moisture content, 1.33 percent nitrogen, 0.11 percent phosphorus, and 0.53 percent potassium, indicating its significant potential as a substitute for increasingly scarce subsidized chemical fertilizers. Research by Migusnawati et al. (2022) also supports this, stating that cassava peel can be used to produce both solid and liquid organic fertilizers due to its beneficial nutrient content for plants. Moreover, the fertilizer production process is relatively simple, making it easier for farmers to apply this technology independently using locally available raw materials, which ultimately saves on production costs while reducing organic waste.

The development of organic fertilizer combined with Trichoderma fungi was presented to the Sumber Tani Farmers Group through socialization activities. This enables the farmers to independently produce organic fertilizer using cassava peel waste available in their surroundings. After applying Savaderma fertilizer to tobacco plants, significant differences were found in the tobacco plants.

Figure 4. Results of tobacco plants that are fertilized
Figure 5. Results of tobacco plants that are not fertilized

The tobacco plants treated with organic fertilizer show better resistance to pest attacks compared to tobacco plants that did not receive this fertilizer treatment. According to research by Utami et al. (2024), Trichoderma fungi can be used as a biological pest control agent for plants. Therefore, Savaderma organic fertilizer, which contains Trichoderma fungi, can minimize pest attacks on tobacco. This finding is consistent with a study by Sujatna et al. (2017), which explains that Trichoderma cultures applied to agricultural land act as biodecomposers, converting organic waste such as leaves and old branches into high-quality compost, while also functioning as a biofungicide to control pathogenic organisms that cause plant diseases. On the other hand, tobacco plants that did not receive Savaderma organic fertilizer tend to be more susceptible to pest attacks, which can lead to significant damage to the crop yield.

There have been many community empowerment activities related to the use of cassava peel. However, some of these activities have not yet reached the stage of application or laboratory testing. Community empowerment activities conducted by Yuhanna et al. (2021) focused on training in compost making, liquid fertilizer production, and fermented feed. Additionally, empowerment activities by Amilia et al. (2024) shifted from introducing products to addressing issues faced by farmers. The empowerment activity involving cassava peel combined with Trichoderma fungi not only provided training and socialization on fertilizer production but also involved laboratory testing of the resulting fertilizer and its application to crops owned by one of the Sumber Tani Farmers Groups. This activity also incorporates

elements from the work of Amilia et al. (2024), as it not only focused on product socialization and fertilizer production but also aimed to address the issue of reducing subsidized fertilizer availability.

This initiative is expected to promote increased agricultural productivity, as the use of Savaderma organic fertilizer makes crops more resistant to pests, leading to better harvests for the Sumber Tani Farmers Group. Additionally, cassava peel waste is often discarded or burned, causing environmental pollution and losing its economic potential. Therefore, the significant potential of utilizing cassava peel and Trichoderma fungi as organic fertilizer creates new economic opportunities for the Sumber Tani Farmers Group. The use of local raw materials and waste can help maintain the environmental balance of the village while reducing fertilizer production costs and dependence on increasingly scarce and expensive subsidized chemical fertilizers.

During the project, one significant barrier encountered was the lack of facilities to grind dry cassava peel. The cassava peel used in the production process needs to be processed into finer particles to proceed to the next stage. However, the absence of equipment for this task led participants to manually grind the peel (by pounding), which prolonged the processing time. This lack of facilities made the grinding process take much longer than expected, as it was done slowly and unevenly.

4. CONCLUSION AND RECOMMENDATIONS

Based on the issues faced by the Sumber Tani Farmers Group, particularly the decreasing availability of subsidized urea fertilizer, it can be concluded that the development of organic fertilizer from cassava peel and Trichoderma fungi can help supplement the use of urea fertilizer. This development is aimed at meeting the fertilizer needs of the farmers in an economically valuable way. Through the community service activities that have been carried out, this initiative has provided knowledge to the farmers regarding the process of making organic fertilizer from cassava peel combined with Trichoderma fungi, which can be produced independently by the farmers group. The Sumber Tani Farmers Group can continue managing the "Savaderma" organic fertilizer product, which is expected to enhance the income of the farmers.

Many farmers are eager for the sustainability of this initiative, so continuous education about the long-term benefits of this organic fertilizer is necessary. This can be achieved by involving more local farmers in trials and production, as well as collaborating with research institutions to develop more effective formulations for application in the fields. Fertilizer diversification can be done to enhance the NPK content by adding other organic materials such as animal manure, leguminous greens, bone meal, and ash from wood burning, straw ash, or coconut husk ash. Additionally, infrastructure improvements are essential, such as providing equipment for waste processing and fermentation spaces with larger capacities, so that large-scale production can be carried out.

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